

Coding Warmup on Slide 19

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```
pzy@LAPTOP-QSQ08ER3:/mnt/g/FSU_Cloud/algorithm_engineering/Zhiyuan_Pan_Algorithm-Engineering/answers/Vorlesung_1$ OMP_NUM_THREADS=4 ./hello
Hello from thread Hello from thread 01
Hello from thread Hello from thread 3
2
```

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```
pzy@LAPTOP-QSQ08ER3:/mnt/g/FSU_Cloud/algorithm_engineering/Zhiyuan_Pan_Algorithm-Engineering/answers/Vorlesung_1$ g++ -fopenmp generated.cpp -o hello2
pzy@LAPTOP-QSQ08ER3:/mnt/g/FSU_Cloud/algorithm_engineering/Zhiyuan_Pan_Algorithm-Engineering/answers/Vorlesung_1$ ./hello2
Hello World!Hello World!
Hello World!
Hello World!
```

pi_numerical_integration.cpp

```
6
7  int main() {
8      int num_steps = 100000000;
9      double width = 1.0 / double(num_steps);
10     double sum = 0.0;
11
12     double start_time = omp_get_wtime(); // start timing here
13
14     #pragma omp parallel
15     {
16         int num_threads = omp_get_num_threads();
17         int thread_id = omp_get_thread_num();
18
19         for (int i = thread_id; i < num_steps; i += num_threads) {
20             double x = (i + 0.5) * width;
21             sum += (1.0 / (1.0 + x * x));
22         }
23
24     }
25
26     double pi = sum * 4 * width;
27     double run_time = omp_get_wtime() - start_time;
28
29     cout << "pi with " << num_steps << " steps is " << setprecision(17)
30     << pi << " in " << setprecision(6) << run_time << " seconds\n";
31
32 }
```

Wrong result:

```
pzy@LAPTOP-QSQ08ER3:/mnt/g/FSU_Cloud/algorithm_engineering/Zhiyuan_Pan_Algorithm-Engineering/answers/Vorlesung_1$ ./pi
pi with 100000000 steps is 0.21023293162228504 in 1.05311 seconds
```

And then asked ChatGPT:

```
14     #pragma omp parallel for reduction(+:sum)
```

Put “reduction(+:sum)” into the code.

```
pzy@LAPTOP-QSQ08ER3:/mnt/g/FSU_Cloud/algorithm_engineering/Zhiyuan_Pan_Algorithm-Engineering/answers/Vorlesung_1$ ./pi2
pi with 100000000 steps is 3.141592653589824 in 0.0306532 seconds
```

I have also tried to use pi_openmp_v1.cpp, the result is:

```
pi with 100000000 steps is 3.1415926535902168 in 0.0746006 seconds
```